Recollections about the Earth Sciences Division
With T.N. Narasimhan

During 1975, the erstwhile Atomic Energy Commission responded to the Arab oil embargo crisis by diversifying research into other forms of energy besides atomic energy. Accordingly, the organization was renamed "Energy Research and Development Administration (ERDA)", with a mission of addressing all forms of energy. To this new mission, LBL responded by launching research efforts into geothermal energy. Because of its peculiar attributes, geothermal energy brought together geophysicists and geologists to explore, locate, and assess geothermal deposits, petroleum engineers to drill for and extract geothermal fluids, and mechanical engineers to separate the heat from the fluid and drive turbines to generate electricity.

Although my own interests were in reservoir engineering aspects of geothermal energy, I tried, with some measure of success, to understand how all the fields from geology to mechanical engineering hung together as a whole. I did field work at East Mesa on the Mexican border, and at Raft River Valley in Idaho. Others worked on the Geysers in Lake County, Klamath Falls in Oregon, and elsewhere. I have been awed by the geology, the landscape, the waterscape, and the natural manifestations of minerals, and energy of the places I have visited in connection with geothermal energy. The natural endowments of this country are spectacular.

A totally new opportunity opened up during 1977, when ERDA was supplanted by the newly created Department of Energy (DOE). We became involved with the disposal, isolation, and storage of radioactive wastes. Research personnel involved in geothermal energy and radioactive waste disposal had attained a critical mass. This resulted in the birth of the Earth Sciences Division.

Over the next two decades, ESD attained notable visibility and stature in two directions: geophysical exploration and seismic studies, and hydrogeology, especially reservoir engineering. Hydrogeology and reservoir engineering closely bought together geochemistry and groundwater. I gained much from interacting with some talented geochemists. As a division we came to be recognized for our innovative approaches to numerical modeling of coupled transport of fluid flow, heat transport, reactive chemical transport, and deformation. On the geochemical side, the division was very actively involved in the selenium toxicity problem at the Kesterson wild-life refuge in the San Joaquin Valley. The selenium problem, which surfaced in 1983, drastically altered societal perceptions about the economic benefits of water relative to the imperative for environmental protection. The mission of energy resource development came to be tempered by the need for minimizing environmental damage.

The 1990s witnessed a gradual change in the flavor of ESD in response to influx of new personnel, new ideas, and emerging missions of DOE. Groundwater contamination at LBL itself became an important issue. Bioremediation, environmental and ecological restoration, climate change are emerging as new areas of research interest. At the basic

sciences level, important work goes on with the use of radioactive isotopes to understand deep earth processes.

Although, as a DOE Facility our primary mission is energy, it is becoming clear that water is going to play an increasingly important role in our mission. Recently, Dr. Chu has highlighted the importance of water in his presentations. This indicates that ESD will have an enhanced role to play in the Lab because of water. Emerging knowledge of water tells us that water problems of the future cannot be solved solely by science and technology. Science will need to forge imaginative connections with the humanities. In form this coming together of science and the humanities will occur in the Earth Sciences Division, one cannot predict. Time will tell.

As I look back over the past, I cannot resist reflecting on the spirit of the Lab. During the 1970s, LBL was still basking in the legacy of curiosity-driven science pioneered by Ernest Lawrence himself. For example, nuclear medicine was reportedly born when Lawrence and his brother decided to explore if the newly gained knowledge of the nucleus would help mitigate their mother's cancer. Surely, scientists did their research to deliver project-funding commitments. At the same time, they were encouraged to use the laboratory facilities to pursue their own research ideas. By the 1990s, Lawrence's vision of inspired research had given way to "mission-oriented" "accountable research." The time-card has since come to dictate the science that one does. Inspired research has become subject to governance by a business model that is probably more relevant for manufacturing. Yet, I recognize that the evolution of the Lab as an institution occurs in response to complex social forces that are beyond our control as scientists and researchers. We have no control over these causes, and we have to do our best to work within the Lab's regulations, and maintain the position of scientific excellence for which we have been recognized the world over for over 75 years.